OPERATION AND SERVICE MANUAL
MODEL TSC-920
SIGNAL CONDITIONER

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RECORDER MANUAL

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Plotting the Future of Graphic Recording

OPERATION AND SERVICE MANUAL
MODEL TSC-920
SIGNAL CONDITIONER

MEASUREMENT & CONTROL SYSTEMS DIVISION
GULTON INDUSTRIAL PARK
EAST GREENWICH, RHODE ISLAND 02818

WARRANTY

RECORDER SYSTEMS DIVISION, Gulton Industries Inc., warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose, and replacing any defective parts thereof (except pens, tubes, fuses and batteries). This warranty is effective for one year after delivery to the original purchaser, when the instrument is returned transportation charges prepaid by the original purchaser, and which, upon our examination, proves to be defective. If the defect has been caused by misuse or abnorman conditions of operation, repairs will be billed at our current rate. In this case, an estimate will be submitted before the work is started. This warranty is in lieu of all other warranties expressed or implied.

MODEL TSC-920 SIGNAL CONDITIONER

DESCRIPTION

1.1 GENERAL DESCRIPTION

The TSC-920 Signal Conditioner is a plug-in module for use in Gulton's TR9200, TR9400, TR9600 and TR9800 portable recorders. This Signal Conditioner has a true differential input with a maximum sensitivity of 10 uv/chart division. The conditioner contains a DC power supply for excitation of external measurement circuits (typically strain gauge bridge configurations) and also features fixed-range, zero-suppress with calibrated dial for expanded-scale recording of AC signals riding on DC levels.

1.2 SPECIFICATIONS, GENERAL

The TSC-920 Signal Conditioner is designed to operate on either of two Gain ranges, identified as the High-Gain Mode and Low-Gain Mode. Selection of the Gain Mode is governed by the Gain Mode Switch (the red knob concentric with the Attenuator Switch). The only operational difference between the two Gain ranges (other than sensitivity) is the Zero-Suppress scale factor. Using the High-Gain Mode, the Zero-Suppress ranges are -10 and -100 Millivolts, full scale; with the Low-Gain Mode, the ranges are -10 and -100 Volts, full scale.

FOR DETAILED SPECIFICATIONS

SEE TABLES ON FOLLOWING PAGES

1.2-1 SPECIFICATIONS - TABLE A

ITEM	SPECIFICATIONS COMMON TO BOTH HIGH & LOW GAIN MODE
Input Configuration	Differential, balanced to Floating Shield
Input Impedance	1 Megohm to each Input to Floating Shield 1 Megohm shield to frame.
Calibration	Internal ±1% (100 mv injected at input when in CAL pos.) Adjust GAIN for 20 Div. to give 1% system calibration.
Span Control	Allows ±10% adjustment of DC excitation voltage
DC Excitation	+5, +10 and +12 Volts, selected by internal Jumper placement
DC Excitation Stability	Line Regulation, 0.1% 105-135 VRMS Load Regulation, 1% 1 to 50 ma Ripple, 1 mv maximum Temperature, 0.5% / 10°C maximum Current Limit, 65 ma typical
Gain Control	Range: 10 through 110% of Calibrated Gain (Screw-driver control)
Stylus Position Control	Range: ±full scale with 0 signal input
Frequency Response (limited by the Recorder in which Signal Conditioner is used)	DC - 40 Hz, 50 Div P/P 1 db. DC - 50 Hz, 20 Div P/P 1 db. DC - 100 Hz, 8 Div P/P 3 db.
Noise	1 Div. maximum with 350 Ohms across input at maximum calibrated sensitivity
Gain Mode Switch	Concentric with Attenuator Switch; 4 positions, namely, "OFF", "CAL", mv/Div." and "μv/Div."
Zero Drift	1 Div./3°C maximum, at Max. Calibrated Sensitivity 1 Div. 8 hours - constant ambient temperature
Gain Stability	1/2% / 10°C., 1/2% 105-135 VRMS
Environmental Tolerances	Operating Temperature Range: 0 to 45°C. Max. Vibration Tolerance: 2 g's, 2 to 100 Hz

Typical of Gulton's Portable Recorders

1.2-2 SPECIFICATIONS - TABLE B

ITEM	Specifications Differing According to Gain Mode	
	HIGH GAIN ONLY (μv/DIV)	LOW GAIN ONLY (mv/DIV)
Sensitivity, Basic	10 μv/Division	20 mv/Division
Attenuator Positions	10, 20, 50, 100, 200, 500, 1000 μv/div.	10, 10, 50, 100, 200, 500, 1000 mv/div.
Common Mode Voltage	±7.5 Volts DC Max., Fuse protected at ±25 Volts	300 Volts DC Max. (between signal inputs & common)
Common Mode Rejection	60 db Min., DC to 200 Hz	60 db Min.
Zero Suppression	2 ranges, independent of attenuator pos. ±100 mv and ±10 mv, front panel SW and 10-turn calibrated pot., Resolution ±0.1% Accuracy, ±2% of F.S.	2 ranges: ±100 Volts and ±10 Volts
Bridge Controls	Zero Balance (R Bal) - 10-turn Pot., balance range of ±10% F.S. Zero balance, WITH gage factor of 3. Bridge Cal - Momentary push-button SW to insert Cal. resistor in bridge arm. Provision for mounting Cal. Res. on front panel.	Not applicable

INSTALLATION

2.1 MECHANICAL INSTALLATION

-- Assembling the TSC-920 Module to the Recorder Frame

The entire Signal Conditioner Module is merely inserted into the appropriate space provided within the Recorder Frame. To make the insertion, hold Module with top and bottom edges of the Printed Circuit Board ( ) aligned with the Guide-Slots in the Recorder.

Apply pressure to the left-hand edge of the Module Front Panel and press firmly inward until face of Module Panel is flush with face of Recorder. Final seating pressure may be applied to the Module knob-handles.

After Module is fully seated, the Module is firmly secured mechanically, to the Recorder Main Frame. In addition, the necessary internal electrical connections are established so that the Signal Conditioner/ Recorder unit is ready for operation as soon as it is properly connected to its signal source, as explained in the following "Electrical Installation" instructions.

2.2 ELECTRICAL INSTALLATION

Information in this sub-section tells how to connect the Signal Input Cable to the Signal Conditioner/Recorder unit; also how to connect Internal Bridge-Completion Resistors (when required).

2.2-1 PRELIMINARY INFORMATION

The signal-source input is conveyed to the Signal Conditioner/Recorder unit via a suitable shielded-type cable.

To provide for the ready interchange of input sources, a plug-in arrangement is used for connecting the Input Cable to the Signal Conditioner/Recorder assembly.

The Input Connector Plug (assembled to end of Cable) inserts into a mating Receptacle located on top or rear panel of the Recorder Frame.

The only electrical wiring required in the field, to install the Signal Conditioner, is (1) Connection of the Input Signal Cable
(2) In certain Bridge Mode applications, connections of one or more Bridge-Completion Resistors within the Signal Conditioner.

2.2-2 SIGNAL INPUT CABLE, DESCRIPTION

The required Cable (to be procured by customer) is a standard, 2, 3 or 4 conductor (depending on application) shielded type, of adequate length to reach between signal-source equipment and the Recorder Receptacle. Cable must be of good instumentation grade.

2.2-3 INPUT CONNECTOR PLUG, DESCRIPTION

This Plug is a standard audio type, made by SWITCHCRAFT (PN-14FL5F). A Connector Plug, or set of Plugs (1 for each channel) is supplied with each Recorder. Additional Plugs, if required, are readily obtainable from most electronic parts distributors.

Design of the Plug is indicated in Figure 2-4. As seen in Figure 2-4C, the Plug has 5 Pins, numbered 1 through 5, reading clock-wise from the Keyway. These numbers are molded onto the end of Plug Insert.

The Input Connector Plug Pins have various functions, as follows:

Pin No.	Pin Function
1	Non-Inverting (Sig.+)
2	Inverting (Sig. -)
3	Frame, Shield, Excitation Return
4	R Bal - Connects to Pin 1 or 2 for Bridge Balance
5	DC Excitation (Positive with respect to Pin 3)

2.2-4 ALTERNATIVE WIRING PLANS FOR SIGNAL INPUT CONNECTIONS

General Explanation

The signal source is connected to the Signal Conditioner in various ways, depending on Mode of operation, also on source characteristics.

For Voltage Mode Operation, there are 4 alternative wiring plans, as shown in Figures 2-5 through 2-8. Select whichever one is appropriate, according to the stated conditions.

When using Voltage Mode, the only installation wiring required consists of the external, input-cable and plug assembly; there are no internal connections to be made within the Conditioner.

FIGURE 2-4 INPUT CONNECTOR PLUG

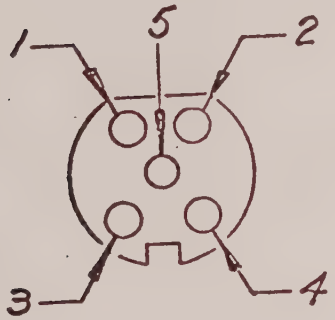
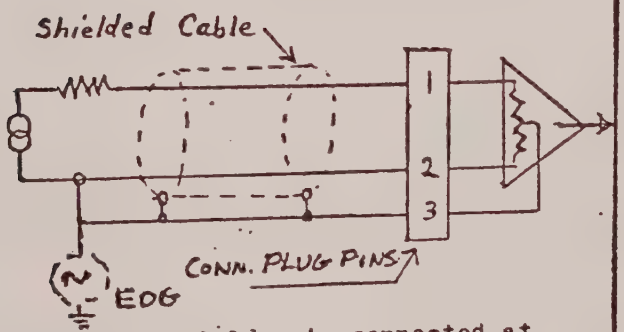


FIGURE 2-5 WIRING DIAGRAM

Limited to: Voltage Mode recording from single-ended, "floating" source



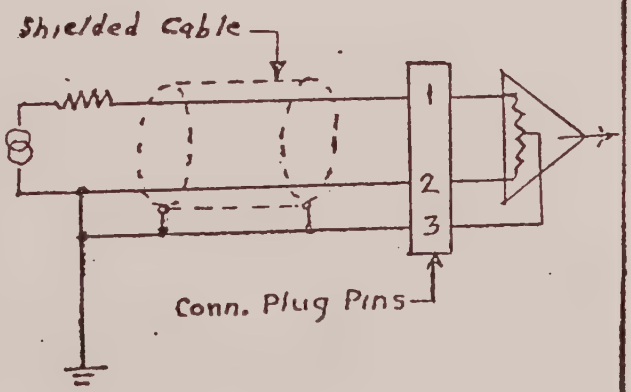
Note that Shield is connected at both ends.

The off-ground voltage on which the signal is riding must not exceed 125 VRMS (when recording from off-ground sources).

The connections to Pins 1 and 2 can be reversed if a change in polarity is desired.

FIGURE 2-6 WIRING DIAGRAM

Limited to: Voltage Mode recording from Single-Ended Grounded Source



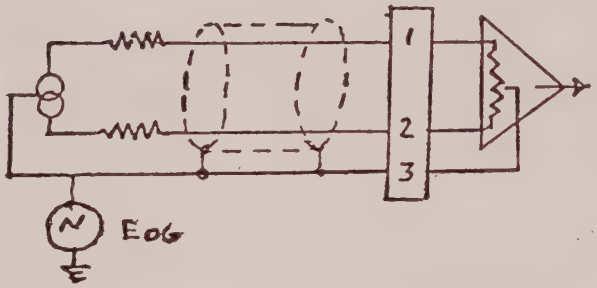
Note that Shield is connected at both ends.

Connections to Pins 1 and 2 can be reversed if a change in polarity is desired.

VOLTAGE MODE - ALTERNATIVE INPUT WIRING (Continued)

FIGURE 2-7 WIRING DIAGRAM

Limited to: Voltage Mode recording from Balanced "Floating" Signal Source



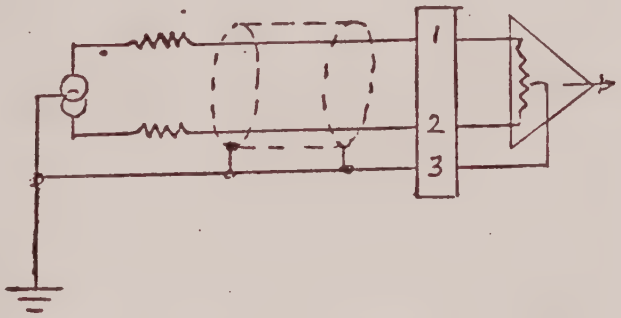
Note that Shield is connected at both ends.

The Common Mode Voltage (Voltage between Pins 2 & 3 or 1 & 3) must not exceed 7.5 Volts DC in the High-Gain Mode or 300 Volts in the Low-Gain Mode.

The Off-Ground Voltage (EOG) must not exceed 125 VRMS.

FIGURE 2-8 WIRING DIAGRAM

Limited to: Voltage Mode recording from Balanced-to-Ground Source



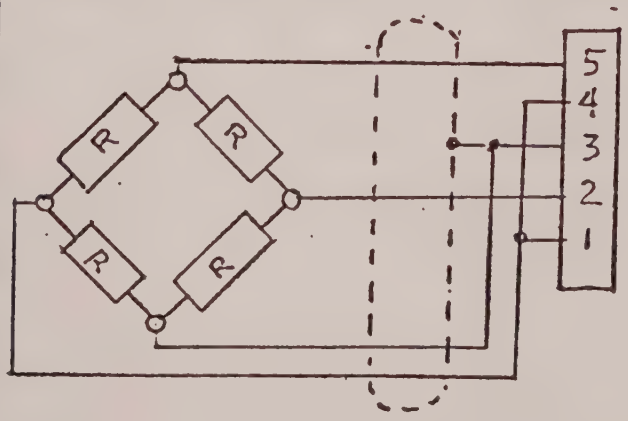
Note that Shield is connected at both ends.

The Common Mode Voltage (Voltage between Pins 2 & 3 or 1 & 3) must not exceed 7.5 Volts DC in the High-Gain Mode or 300 Volts in the Low-Gain Mode.

2.2-4B BRIDGE MODE - ALTERNATIVE INPUT WIRING

FIGURE 2-9 WIRING DIAGRAM

Limited to: Bridge Mode recording from 4-Element External Strain Gauge (full Bridge).



Connect Shield at either or both ends.

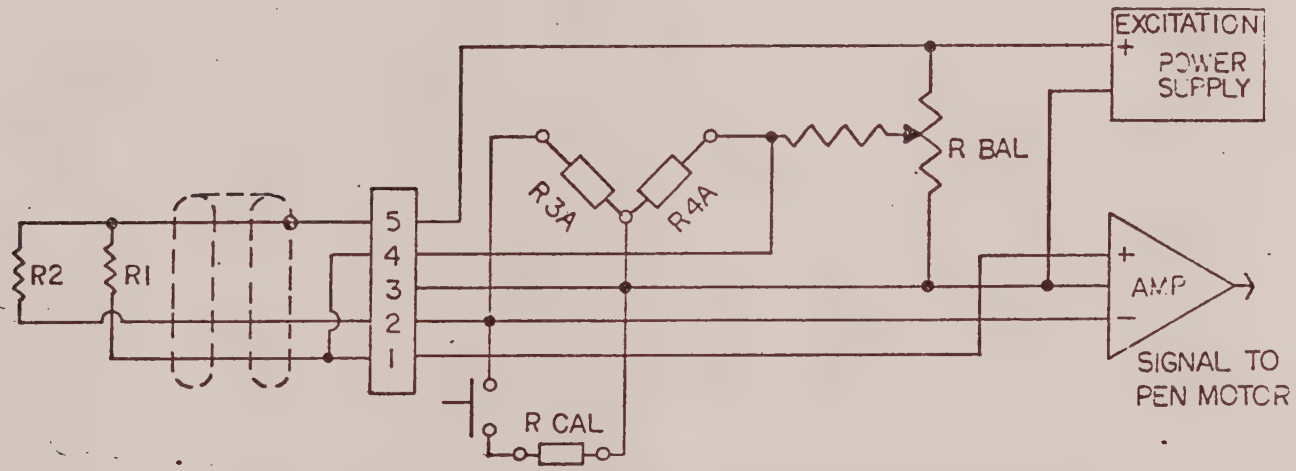
Use twisted, shielded cable for minimum noise pick-up.

Note: NO Internal Bridge-Completion Resistors required in this application (with a full External Bridge).

BRIDGE MODE - ALTERNATIVE INPUT WIRING
(Continued)

FIGURE 2-10 WIRING DIAGRAM

Limited to: Bridge Mode recording from External, 2 Element Strain Gauge



Note that Shield is connected at one end only.

Use same wire size for all leads.

Install 2 Internal Bridge-Completion Resistors (R4A & R3A) as shown. Value should equal External Arm Resistance, R.

Use 0.1% or better, wire-wound Resistors.

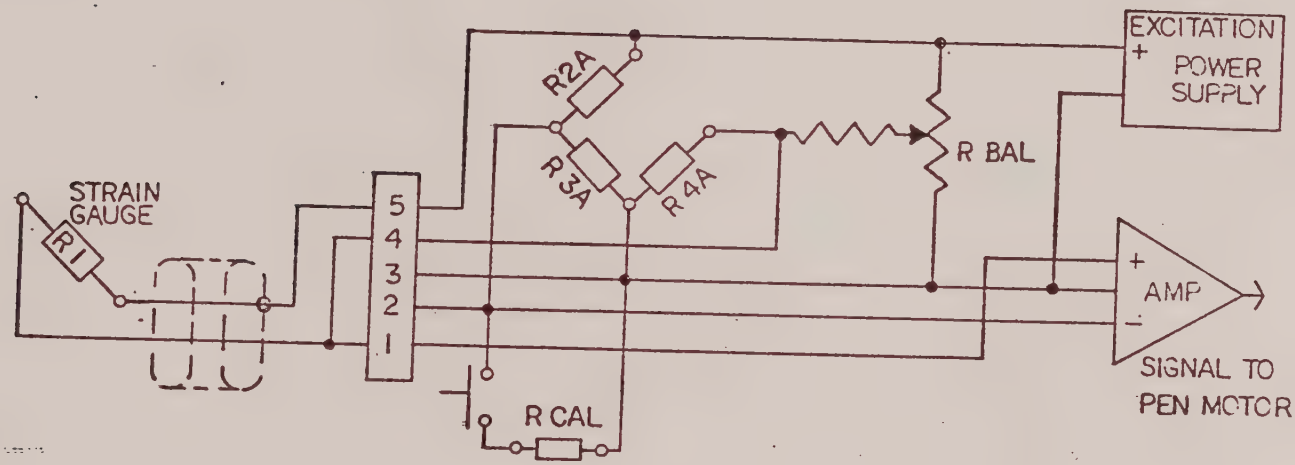
R1-R2 external connections.

R1-R4 and R2-R3 external connections disallowed.

BRIDGE MODE - ALTERNATIVE INPUT WIRING (Continued)

FIGURE 2-11 WIRING DIAGRAM

Limited to: Bridge Mode recording from Single-Element, External Strain Gauge



Note that Shield is connected at one end only.

Use same wire size for all leads.

Install 3 Bridge-Completion Resistors (R4A, R2A, R3A) as shown. Two of the Resistors (R2A & R3A) can be of arbitrary resistance value, as long as they are matched to within ±0.2%. The third Resistor (R4A) should be matched to within ±0.2% of the unstressed Strain Gauge resistance.

Note that in this application (using single-element Strain Gauge) the TSC-920 Signal Conditioner allows for only a two-wire connection to the input. Consequently, significant errors can occur due to changes in lead wire resistance caused by temperature variations. It is therefore highly recommended that a dummy Gauge be used instead of the third resistor (R2A) within the Conditioner. The dummy or Compensator Gauge should be located in close proximity to the Active Gauge to minimize any temperature differential between it and the Active Gauge. For proper connection, see Figure 2-10.

Connection for R1 External shown in Figure 2-11, for opposite pen deflection, R2 can be made external with R1 internally connected.

Legend

(1) Gain Pot Adjustment

(2) Position-Control Switch and Lock

(3) Attenuator Switch (Black Knob)

(4) Gain Mode Switch (Red Knob)

(5) Bridge R Balance (10-Turn)

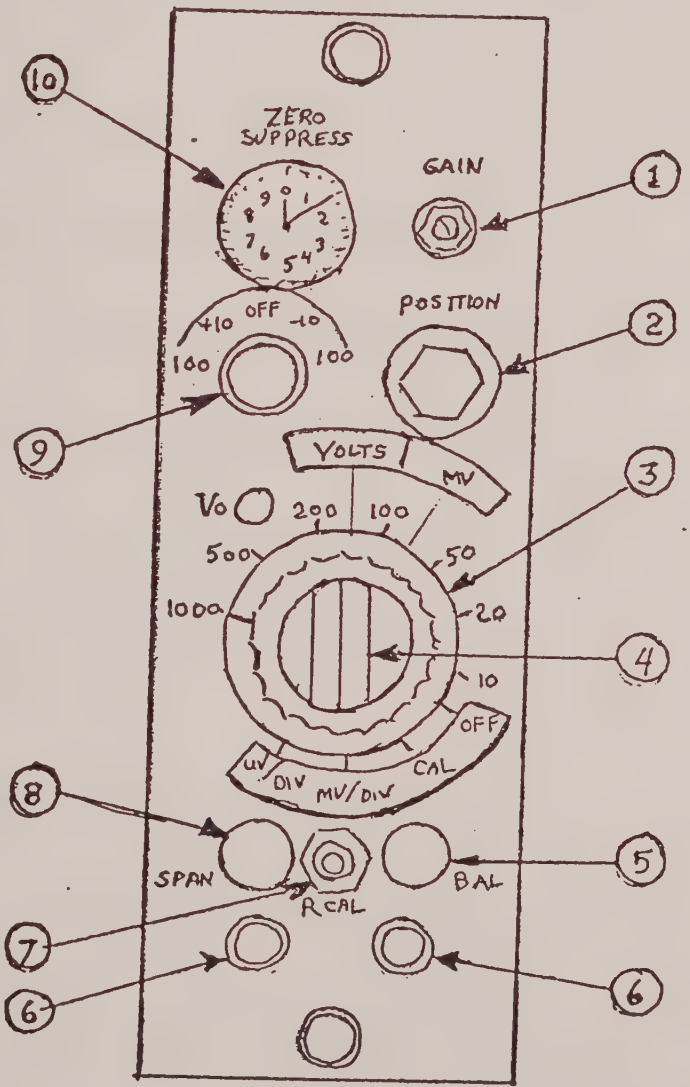
(6) Binding Post for Cal. Resistor Installation

(7) R Cal Push-Button Switch

(8) Span Pot Knob (10-Turn)

(9) Zero-Suppress-Function Switch

(10) Zero-Suppress Pot (10-Turn)



FRONT PANEL CONTROLS

Figure 3-1

3.2-4 Gain Calibration
After completing 3.2-3

(1) Turn Gain Mode Switch to the CAL position, and

(2) Adjust Gain Control Pot (using screwdriver) for 20 div. deflection from the zero baseline. NOTE: if the zero baseline has been set at the right - hand margin, it will be necessary before making the Gain Calibration to shift baseline to chart center, and then return it to right-hand setting after Gain Calibration is complete.

3.2-5 Offset Voltage Check
After Gain is properly calibrated

(1) Return Gain Mode Switch to the OFF position and recheck the zero baseline position.

(2) Place Gain Mode Switch in the MV/DIV position and advance the Attenuator Switch from 1000 to 10.

The Stylus should remain within one division of the zero baseline. If not, adjust.

(3) Adjust the V_o Control (accessible through the front panel) to reposition the Stylus to the zero baseline.

(4) Return Gain Mode Switch to OFF and Attenuator Switch to 1000.

3.2-6 Recording the Signal - Initial Procedure

(1) Connect input signal to the Recorder

(2) Turn Chart Drive on

(3) Set the Gain Mode and Attenuator Switches according to the dictates of the input signal amplitude.

3.2-7 Recording the Signal - Secondary Procedure If Required (to correct non-symmetrical stylus trace)

Certain input signals-with both AC and DC components- may cause the Stylus to swing further to one side of the pre-set zero baseline than to the other. If so, one of two corrective measures will be required, namely:

3.2-7A Position Control Re-Adjustment

Provided the DC offset is not greater than 50% of the F.S. range (at the existing Attenuator setting), the Stylus Position Control can be

OPERATION

3.1 INTRODUCTION

Two separate sets of operating instructions are provided for the TSC-920 Signal Conditioner, one for Voltage Mode (3.2) and another for Bridge Mode (3.3) since a different operating procedure is required for each Mode.

With Voltage Mode operation, the Signal Conditioner is used as a straight-forward voltage pre-amp; therefore the Bridge Controls and the internal excitation voltage are not used.

With Bridge Mode operation, the Signal Conditioner is used to measure signals from a Wheatstone Bridge configuration, for which purpose both the internal excitation voltage and the Bridge Controls are employed.

3.2 VOLTAGE MODE OPERATING PROCEDURE

3.2-1 Initial Pre-Amp Set-up

Remove Signal Conditioner unit from Recorder Frame and check that there are no resistors tied to the Bridge-Completion Binding Posts, located on the small printed circuit sister board. Then replace Signal Conditioner in Recorder.

3.2-2 Initial Control Settings

(1) Set Controls as follows:

Zero Suppress Switch	OFF
Gain Mode Switch	OFF
Attenuator Switch	1000

(2) Disconnect the Input Conn. Plug.

(3) Turn ON Recorder Main Power Switch with the Chart Drive OFF. Allow Recorder and Signal Conditioner to warm up for 5 minutes, minimum.

(4) Set Chart Speed for 0.5 mm/second.

3.2-3 Zero Base Line Set-up

(1) Decide where the Zero Baseline is best positioned. For normal operation, where + and - signals will be recorded, the base line is best set at center scale. If only Pos. or Neg. signals are to be recorded, left or right chart margin, respectavely, would be the choice.

(2) Having decided where zero baseline is to be, unlock and turn the Position Control to set Stylus to the desired baseline position, then lock the Position Control.

3.2-4 Gain Calibration
After completing 3.2-3

(1) Turn Gain Mode Switch to the CAL position, and

(2) Adjust Gain Control Pot (using screwdriver) for 20 div. deflection from the zero baseline. NOTE: if the zero baseline has been set at the right - hand margin, it will be necessary before making the Gain Calibration to shift baseline to chart center, and then return it to right-hand setting after Gain Calibration is complete.

3.2-5 Offset Voltage Check
After Gain is properly calibrated

(1) Return Gain Mode Switch to the OFF position and recheck the zero baseline position.

(2) Place Gain Mode Switch in the MV/DIV position and advance the Attenuator Switch from 1000 to 10.

The Stylus should remain within one division of the zero baseline. If not, adjust.

(3) Adjust the V_o Control (accessible through the front panel) to reposition the Stylus to the zero baseline.

(4) Return Gain Mode Switch to OFF and Attenuator Switch to 1000.

3.2-6 Recording the Signal - Initial Procedure

(1) Connect input signal to the Recorder

(2) Turn Chart Drive on

(3) Set the Gain Mode and Attenuator Switches according to the dictates of the input signal amplitude.

3.2-7 Recording the Signal - Secondary Procedure If Required (to correct non-symmetrical stylus trace)

Certain input signals-with both AC and DC components- may cause the Stylus to swing further to one side of the pre-set zero baseline than to the other. If so, one of two corrective measures will be required, namely:

3.2-7A Position Control Re-Adjustment

Provided the DC offset is not greater than 50% of the F.S. range (at the existing Attenuator setting), the Stylus Position Control can be

3.2-7A re-adjusted to establish a new zero baseline and obtain a symmetrical Stylus sweep.

OR

3.2-7B Zero Suppression Operation

If the above Position Control Re-adjustment is impracticable, Zero Suppression can be used to offset DC signals up to 100 Volts. Typically, Zero Suppression allows a more sensitive Range Switch setting when large DC signals are present, while at the same time allowing measurement of the total signal amplitude.

Proceed as follows:

(1) First, without using Zero Suppression, record the signal to be investigated and note the approximate peak-to-peak amplitude of the AC as well as DC signal components. Best results are obtained using a margin zero, that is, by initially setting the baseline trace at the left or right-hand margin of its channel (left, if DC component is positive; right, if negative). To set this "zero", use the Position Control, while the Function Switch is in OFF position. DO NOT TOUCH THE POSITION CONTROL THEREAFTER, as all readings will be taken from this initial "zero".

(2) Setting the Suppression Controls

In the mv/DIV Gain Mode, the Zero Suppress ranges are -10 and -100 mv., which are selectable by the Zero Suppress Function Switch.

In the mv/DIV Gain Mode, the Suppress ranges are -10 and -100 Volts.

A precise setting of any voltage within these ranges is made by means of the 10-turn Calibrated-Dial Suppress Potentiometer.

Example:

To suppress a 71 mv DC signal, the High-Gain Mode (uv/DIV) would be selected, and the Suppress Function Switch placed in the -100 position (-100 mv full scale suppression capability). The 10-turn Calibrated Dial would then be set to 71.

(3) Recording the Signal

Turn the Attenuator Switch to a sensitivity which allows the AC signal component to stay on scale. A minor adjustment of the Zero Suppress Pot may be needed to keep the trace on scale.

To determine the total signal amplitude, simply read the voltage off the chart (number of DIV. deflection from zero baseline times Attenuator setting) and add to this reading the setting of the 10-turn Dial times the suppression range.

3.3 BRIDGE MODE OPERATING PROCEDURE

3.3-1 Initial Set-up

Before (a) setting the excitation level
(b) adding internal Bridge-Completion Resistors or
(c) making any Signal Input Connections

The Signal Conditioner should be checked out and set up according to the procedures given for Voltage Mode Operation (3.2-1 through 3.2-5)

3.3-2 Excitation-Level Selection

Having completed the Initial Set-up above, turn OFF Recorder power supply and remove the Signal Conditioner from the Recorder Frame.

The TSC-920 Signal Conditioner offers a choice of 4 voltage levels, namely, 5, 8, 10 or 12 V., governed by the positioning of a Jumper Plug.

The voltage level should be selected in accordance with (a) the Strain Gauge manufacturer's recommendations for the particular Gauge being used, and (b) the maximum loading capability of the Signal Conditioner's power supply. To select maximum allowable voltage levels for various Gauges, refer to the following table.

Example: For a 120 Ω Bridge, 5V. is the highest level which can be used.

VOLTAGE LEVEL	JUMPER POSITION	MAX. CURRENT	RESIST LEAD RANGE (Bridge Input)
5 V	1	50 ma	100 Ω TO ∞
8 V.	2	50 ma	160 Ω To ∞
10 V.	3	50 ma	200 Ω To ∞
12 V	4	50 ma	240 Ω to ∞

3.3-3 Bridge Completion Resistors Installation

Locate and loosen the appropriate binding posts. Refer to Figure 2-9 through 2-11 for selecting resistors. Install required resistors and reinstall conditioner into recorder mainframe and turn recorder power on.

3.3-4 Zero Balance Procedure

(1) Unload the measurement bridge, i.e., zero the bridge input, (zero strain, pressure, force, etc.) to give a balanced output -0 Volts.

(2) Set the Attenuator to mid-range (200)

(3) Set Gain Mode Switch to uv/DIV

(4) Adjust R Bal Control to set Stylus to the zero baseline

(5) Increase sensitivity to 10 uv/DIV and re-adjust R Bal if necessary to the zero baseline

3.3-5 Calibration

Note, for this procedure, choose any of the following 3 alternative methods, as appropriate (A, B or C)

A - Shunt Calibration

On the Signal Conditioner Front Panel, 2 terminals are provided for installation of a Shunt Calibration Resistor. After being so installed, this Resistor is connected across a Bridge Arm whenever the R Bal Switch is closed. When thus connected, the Shunt Resistor unbalances the Bridge, with the amount of unbalance corresponding to a fixed, static load on the Bridge. Typically, the Resistor is selected to represent an 80% F.S. load.

Shunt Calibration Procedure

With the Calibration Resistor in place in the Signal Conditioner and with Bridge connected and zeroed,
(1) Hold the R Cal Switch and set the Attenuator Switch for a convenient scale deflection.

(2) Read the voltage off the chart.

This voltage is the Bridge output for a calculated input, from which a scale factor can be calculated to relate volts to the engineering units of the Bridge input.

B - Calibration with a Known Bridge Load

Instead of a Shunt Resistor, it may be more desireable in some cases to use a known input to the Bridge, i.e., a calibrated mechanical load, pressure or strain input. The procedure is generally identical to that when using a Shunt Resistor; however, instead of using the Signal Conditioner R Cal Switch, apply the calibrated load, after first zero-balancing the Bridge.

Here, too, the chart read-out is in volts, and a scale factor can be calculated from the calibrated load.

C - Calibration for Direct Chart Read-out in Engineering Units

With this technique, voltage gain calibration of the Signal Conditioner is lost in favor of obtaining a direct readout in engineering units (u-strain, PSI, etc.).

To calibrate in this manner:

(1) Zero the Bridge as previously described, then use either a Shunt Resistor or calibrated load to give a known output from the Bridge.

(2) Set the Attenuator Control for a reasonable display of this calibrated signal (30 to 50 divisions deflection from the zero baseline - assuming zero baseline is set at left or right-hand chart margin).

(3) The calibrated Bridge load should represent some percentage of the F.S. Bridge output, so adjust the GAIN Control on the Conditioner for that same percentage of F.S. chart deflection. Example: If the calibrated load represents an 80% F. S. Bridge output, adjust the Gain Control for exactly 80% F. S. deflection (40 divisions) from the zero baseline.

(4) The Attenuator range is now calibrated to Full Scale Bridge output with a sensitivity of F. S. units/50 per division. The sensitivity on the other Attenuator ranges can be determined by the Attenuator Gain factors.

MAINTENANCE

4.1 PERIODIC PREVENTIVE MAINTENANCE, GENERAL

Detailed in this Section, under the headings "Preventive Maintenance", are those procedures deemed essential to insure the continuing operation of the TSC-920 Signal Conditioner at peak efficiency.

Under normal-use conditions, the recommended maintenance - both mechanical and electrical - should be performed at six-month intervals. Under severe operating conditions, the program should be repeated every 90 days.

4.2 Preventive Maintenance, Mechanical

4.2-1 Preliminary

Turn OFF all power.

Remove the Preamplifier from the Recorder by grasping the top and bottom Handle-Knobs and then pulling the entire Preamp Unit straight out.

4.2-2 Cleaning

Using suitable air hose, blow out loose dust and dirt.

Inspect for any foreign particles and remove if present.

Clean the Preamp Panel and Handle-Knobs with a moist cloth, then wipe dry with soft clean cloth.

4.2-3 Tightness Check

Inspect the Preamplifier and Power Supply for loose parts (transistors, plug-in components, resistors, condensers, controls, terminal boards, mounting boards, rectifiers, fuses, transformers, etc.).

Check that all panel-mounted components are securely in place, that all locking controls will lock securely, and that each Control Knob is tight on its shaft.

4.2-4 Damage Check

Inspect visually and by smell for burned or worn insulation, leaking or damaged resistors, condensers, transformers, etc. Inspect also for corrosion, rust, and electrical or mechanical abuse.

4.2-5 Replacement

Reinstall the equipment and fasten securely.

4.3 PREVENTIVE MAINTENANCE, ELECTRICAL

4.3-1 Note: The instructions to follow cover recommended electrical checks and calibrations of the Signal Conditioner only. Following completion of the Signal Conditioner maintenance, the total Signal-Conditioner/Recorder System also should be checked - for linearity and frequency response (per instructions in the applicable Recorder Manual).

4.3-2 Test Equipment Required

(1) Digital Volt Meter - 4-1/2 Digit, 100 uv Resolution, 0.1% accuracy or better.

(2) Extender Card - Gulton Model TAC 321.

(3) Variable DC signal source.

4.3-3 Preparatory

It will be necessary to provide access to various internal adjustments while the Signal Conditioner is connected and operating. To accomplish this, remove Signal Conditioner from Recorder and insert in its place the TAC-321 Extender Card. Then plug the Conditioner into the connector on front of the Extender Card.

4.3-4 Initial Set-up

(1) Turn ON Recorder main power, then set Chart speed to LOWEST setting.

(2) Set the Signal Conditioner Controls as follows:
GAIN MODE - off
Zero Suppress - off
Position Control - Center scale, zero baseline

(3) Disconnect the Input Signal Cable

(4) Remove all Bridge-Completion Resistors

4.3-5 Output V° Adjustment

(1) Set Gain Mode Switch to OFF

(2) Using screw driver, set GAIN Control Max. CCW

(3) Adjust Position Control for exact center scale Stylus position, and lock the Control

(4) Re-set GAIN Control to Max. CW position

(5) Adjust Output Vo Pot (R22) to re-set Stylus to exact center scale. (For location of R22 refer to figurs 4-)

4.3-6 Input Vo Adjustment

After completing Output Vo Adjustment,

(1) Set Gain Mode Switch to MV/DIV

(2) Without touching the Position Control, adjust Input Vo Pot (R12), accessible through Front Panel, for exact center scale Stylus position

(3) Switch back and forth between MV/DIV and OFF, checking to assure there is no offset between OFF and MV/DIV., re-adjusting R12 if necessary.

4.3-7 Internal CAL Voltage Adjustment

(1) Using a variable DC source and a DVM, insert a 20.0 mv signal at the input signal Connector. (for proper connection signal source, see Figure 2-5 Section 2)

(2) Set operating controls thus;

Gain Mode - uv/DIV
Attenuator - 1000
Zero Suppress - OFF

(3) Adjust Gain Control for exactly 20 DIV deflection from zero baseline. (Check Zero Baseline by switching Mode Switch to OFF position).

(4) Switch Gain Mode to CAL position. Stylus now should be at the same 20 DIV deflection observed in step (3); if not adjust R49 accordingly. (for location of R49 see Figure 4-)

4.3-8 Zero Suppress Calibration

(1) Set the variable DC source (connected as in 4.3-7) to -100 mv, using the DVM to measure the input signal

(2) Set the Gain Mode Switch to OFF and adjust the Position Control if necessary for center scale zero baseline.

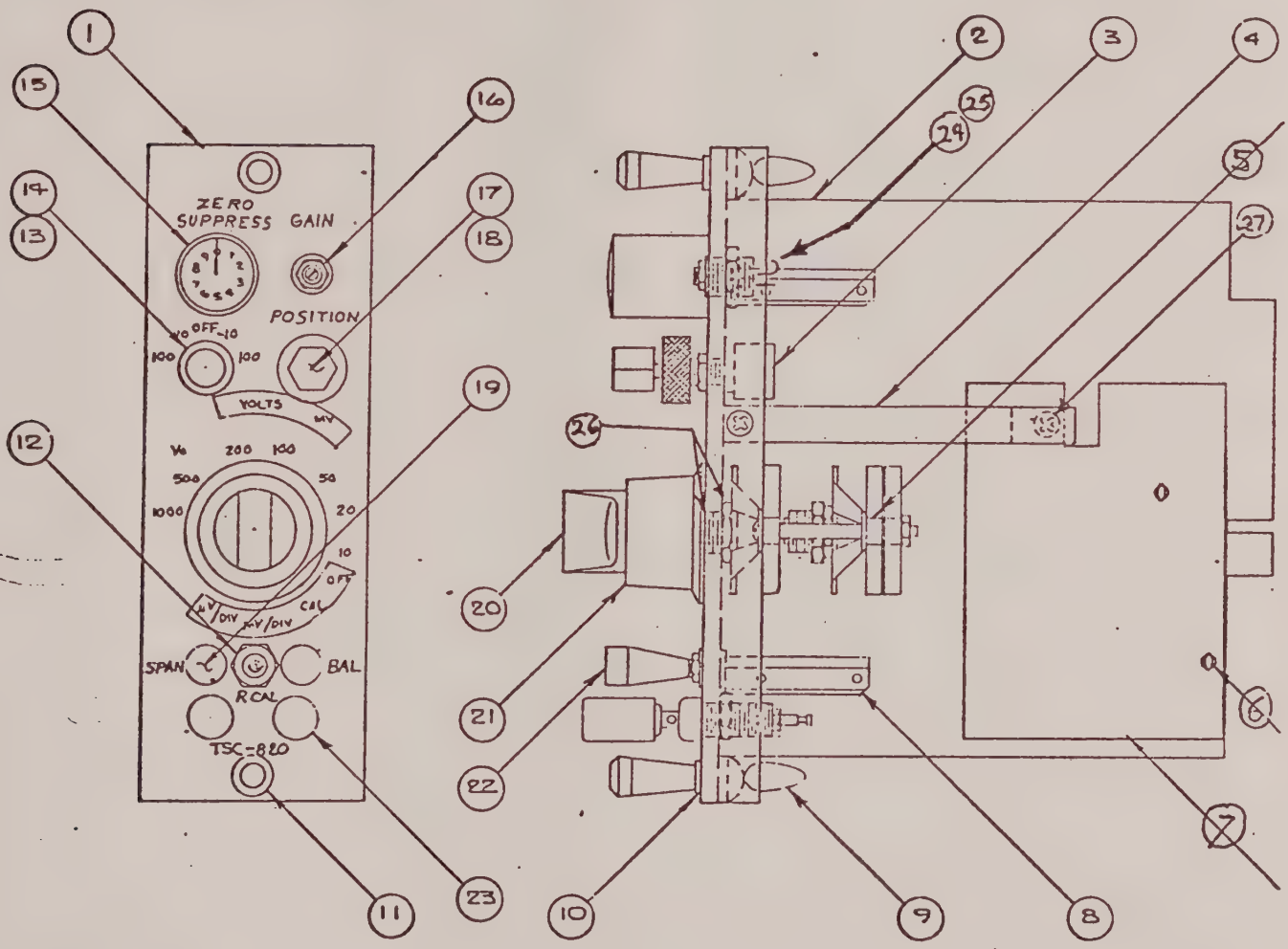
(3) Set; Attenuator to 1000
Zero Suppress to -100
10-Turn Suppress Pot to 10.0
Gain Mode Sw. to uv/DIV

The Stylus should remain at the center zero baseline (the 100 mv input signal being exactly cancelled by the internal suppress voltage).

(4) Step the Attenuator through to maximum sensitivity (10), adjusting R32 as necessary to maintain the Stylus position at center scale. (for location of R32, see Figure 4-).

THIS COMPLETES THE RECOMMENDED PREVENTIVE MAINTENANCE PROCEDURE

Module Assembly
No. 403625

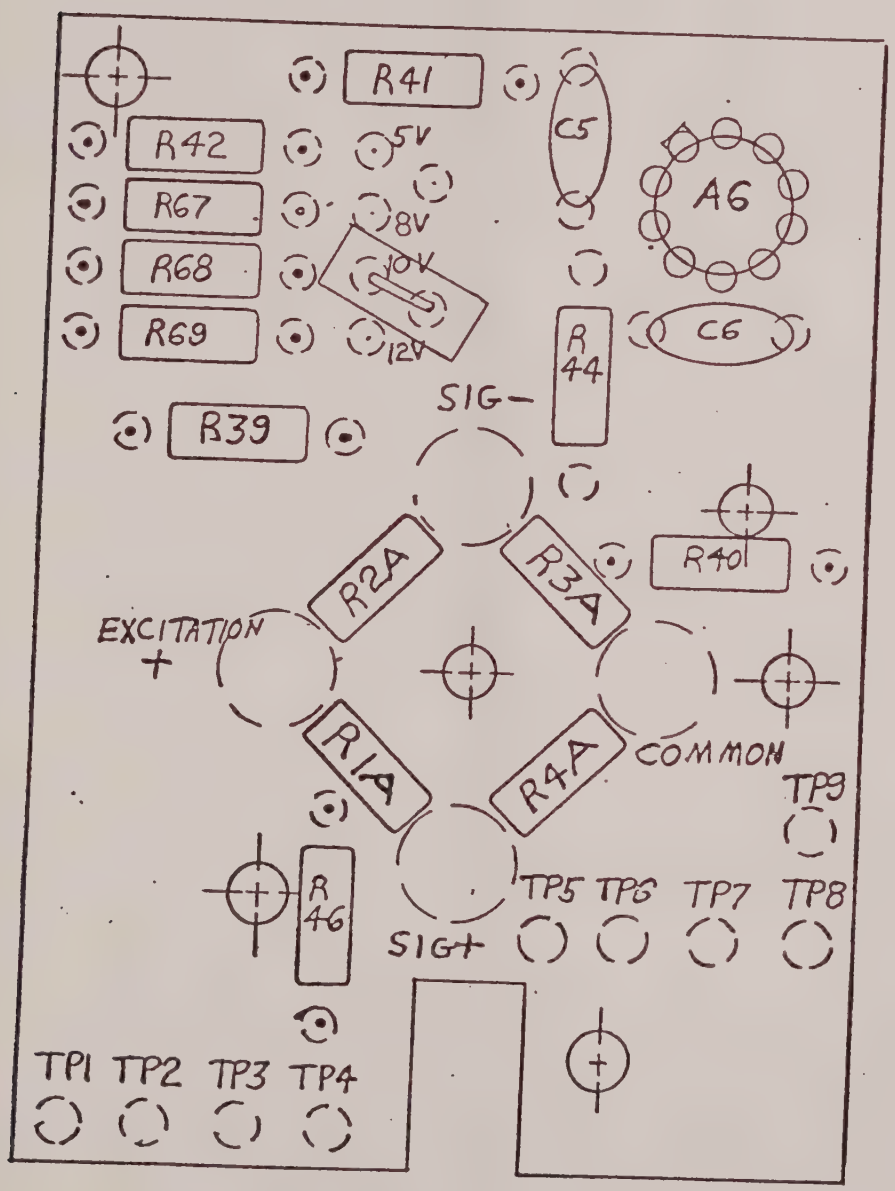


TSC-920 SIGNAL CONDITIONER

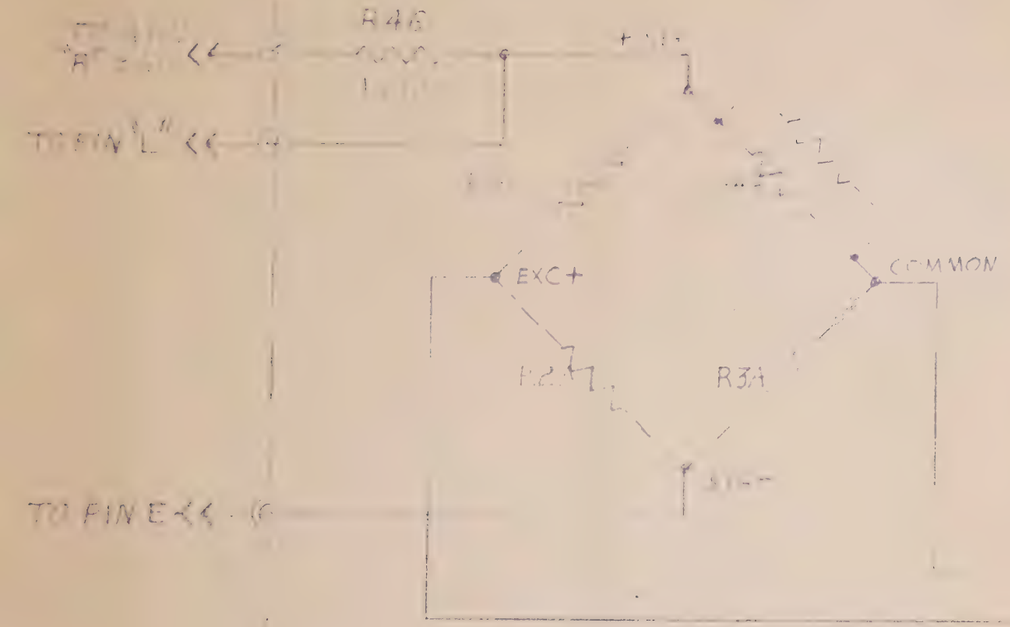
PARTS LIST
MODULE ASSEMBLY NO. 403625

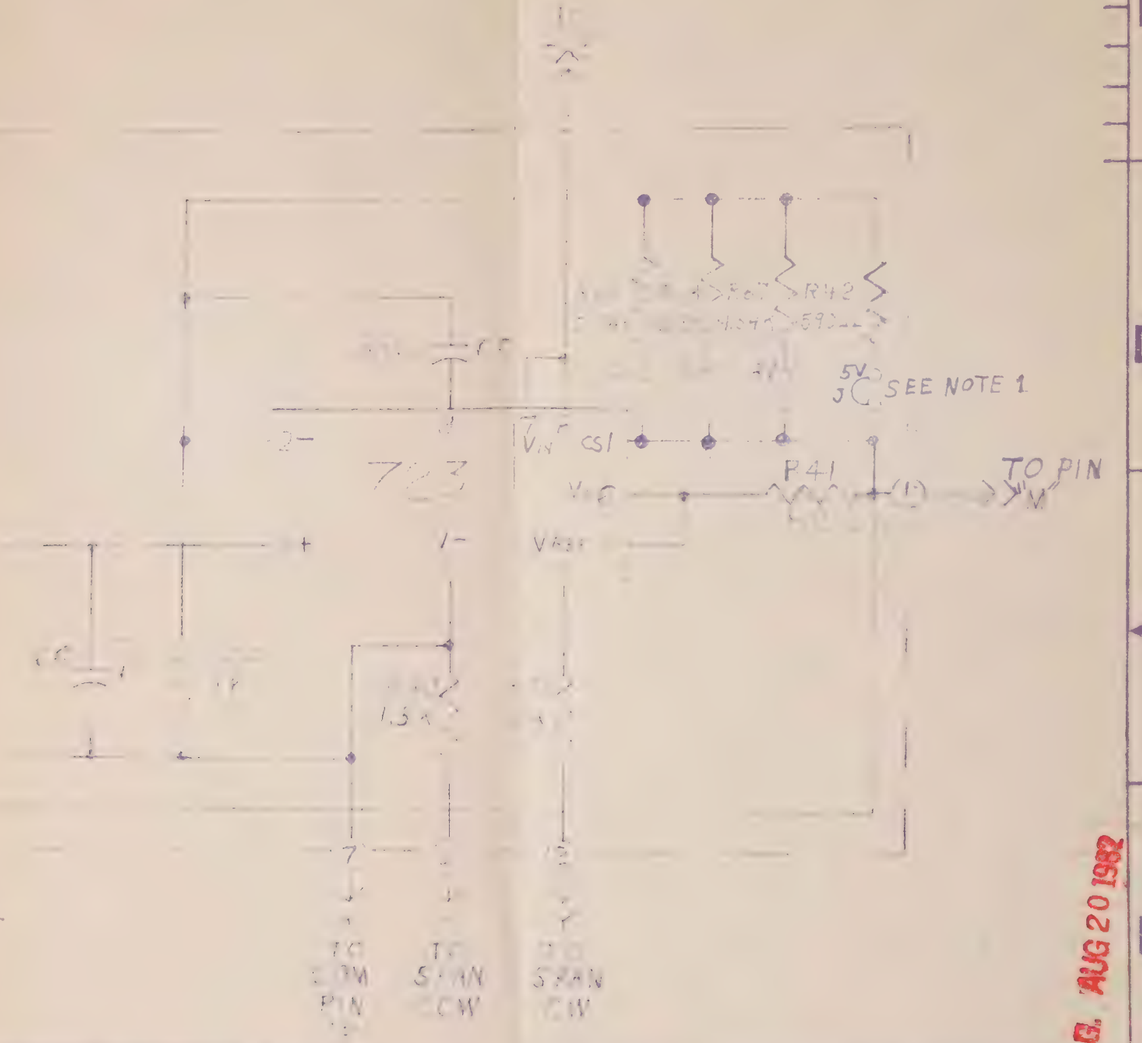
FIND No.	REF. DESG.	QUAN. REQ.	PART NUMBER	PART NAME
1		1	B-402151	PANEL, FRONT
2		1	403850	ASSY. P.C.B., PRE-AMP
3		1	202185	ASSY. P.C.B., VOLT. REG.
4		1	107291	STRAP
5		1	103750-5/8	SPACER, NYLON
6		2	103750-3/4	SUPPORT, P.C.B.
7	R51	1	110795-203	POTENTIOMETER, POSITION
8		1	110442	KNOB
9		1	110632	SHAFT LOCK
10	R23	1	107382-253	POTENTIOMETER, GAIN
11	S2	1	106736	SWITCH, ROTARY
12		1	110545	KNOB
13	S1	1	202897	ASSY. ATTENUATOR
14		2	102066	WASHER, INS.
15		1	110547	KNOB, CONCENTRIC
16		2	107379-0	BINDING POST
17	S3	1	107380-3	SWITCH, P.B. (R CAL.)
18	R45	1	107382-203	POTENTIOMETER, BAL.
19	R43	1	107382-501	POTENTIOMETER, SPAN
20	R29	1	1-107381-502	POTENTIOMETER, (10 TURN)
21		2	110344	KNOB
22		2	104343	PLUG, BANANA
23		REF.	403848	SCHEMATIC
24	R27	1	100549-1542	RESISTOR, 1% MF 15.4K
25	R26	1	100549-1963	RESISTOR, 1% MF 196K

Precision Voltage Regulator Assembly
No. 202185



ZONE	SYM	DESCRIPTION	DATE	APPROVED
	B			
	-			





(5) TO ARM OF SPAN CONTROL

NOTES: 1. JUMPER SELECTS EXCITATION VOLTAGE.

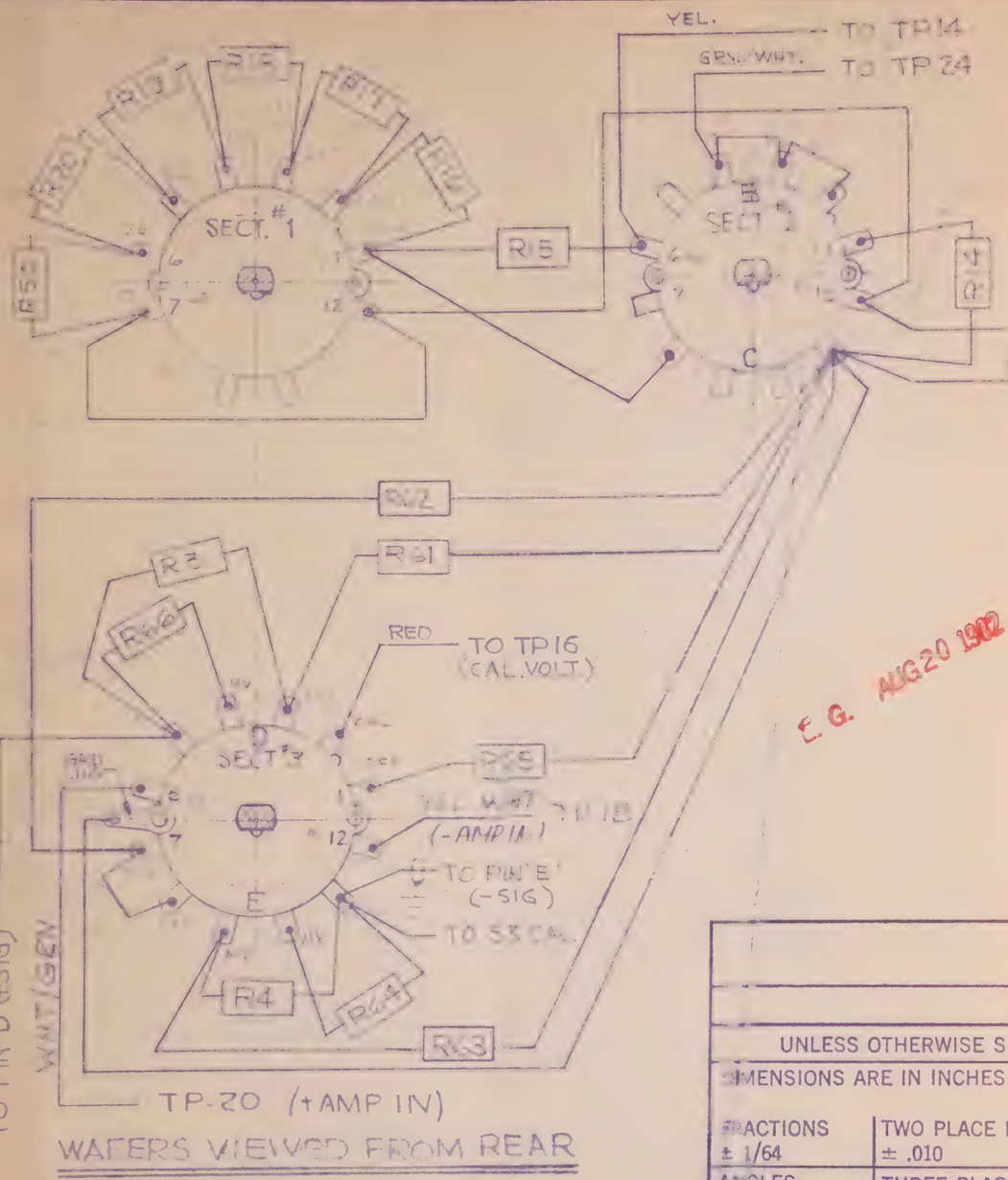
E.G. AUG 20 1982

UNLESS OTHERWISE SPECIFIED	DRAWN BY	Gulton techni-rite ELECTRONICS
DIMENSIONS ARE IN INCHES: TOLERANCES ON: FRACTIONS ± 1/64 | DECIMALS ± .005 | ANGLES ± 1°	CHECKED BY:	
REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING.	CONTRACTOR APPROVAL:	
MATERIAL:	DESIGN APPROVAL	SIZE B | CODE IDENT NO. | DWG. NO 20183
	DOCUMENTATION APPROVAL:	SCALE: | CONTRACT NO | SHEET 1 OF 1

NEXT ASSEMBLY	USED ON
APPLICATION	

ERASA DURE

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED SEC. #3 PER MKD PRINT	9-8-75	33302
B	SEC. 1 & 3 REWIPED PER MKD PRINT	10-9-75	31417
C	REMOVED TSC-920W FROM REF. BLOCK	2-9-76	32 [illegible]



NOTES:
1. USE SHRINK TUBING OVER INDEX LUG & ISOLATE UNIT FROM FRONT PANEL WITH NYLON OR MYLAR WASHER.
2. USE #24 AWG STRANDED WIRE, COLOR CODE AS SHOWN; USE #24 AWG BUSS WIRE FOR JUMPERS & SHLD. WIRE WHERE SHOWN.
3. MADE DESIG REF. ONLY

REF. DESG.	FIND NO.	QUAN REQ	PART NO. OR IDENTIFYING NO.	DESCRIPTION
R66		4	100549-1001	RESISTOR 1K
R62 R64 R65				
R61, R63		1	1-100549-1001	RESISTOR 1K (MATCH'D. PR.)
R50		1	100549-1243	RESISTOR 124 K
R20		1	-7502	75 K
R19		1	-2492	24.9K
R18		1	-1242	12.4K
R17		1	-750	7.5K
R15, R16		2	-2491	24.9K
R14		1	100549-4991	RESISTOR 4.99K
R3, R4		1	1-100541-1004	RESISTOR 1MEG. (MATCH'D PR.)
S1		1	202871	SWITCH, ROTARY

PARTS LIST

402484	TSC-822
403625	TSC-920
[illegible]	TSC-820
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES:

FRACTIONS ± 1/64	TWO PLACE DECIMALS ± .010
ANGLES ± 1°	THREE PLACE DECIMALS ± .005

REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. MACHINE SURFACES TO BE 63 RMS.

MATERIAL: SEE PART

FINISH:

DRAWN BY: E. PRIOR
DATE: 11-6-74
CHECKED BY:
DATE:
CONTRACTOR CERTIFICATION:
DATE:
DESIGN APPROVAL:
DATE:
DOCUMENTATION APPROVAL:
DATE:

RECORDER SYSTEMS DIVISION
Gulton Industries Inc.

ATTENUATOR, ASSEMBLY

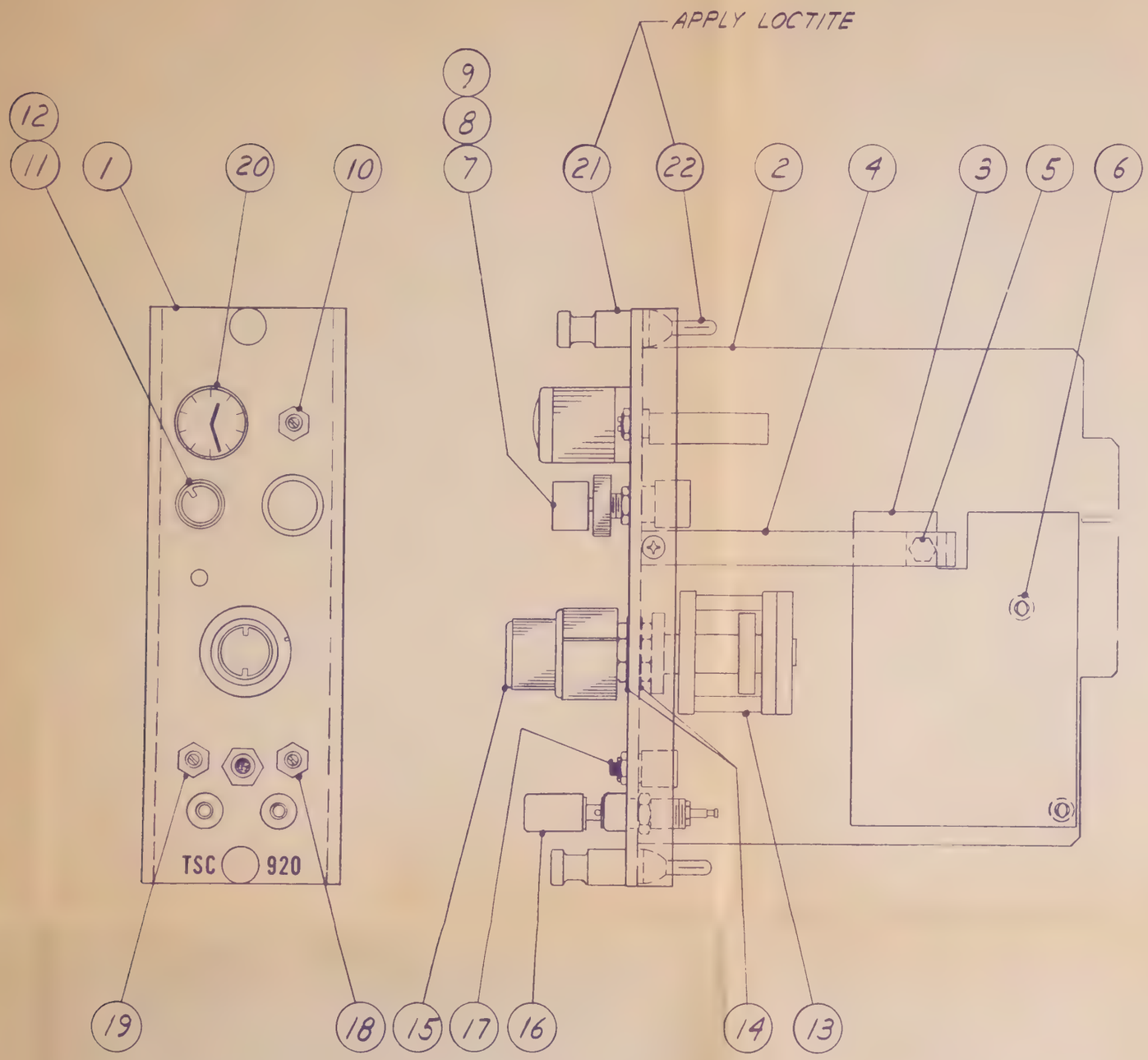
CODE IDENT	SIZE	DWG NO.
04	B	202897

SCALE | CONTRACT NO. | SHEET 1 OF 1

E. G. AUG 20 1982

PAP-175

LTR	DESCRIPTION	DATE	APPROVED
	FIND 16 WAS 107379-2 (RED)	6-15-78	
C	FIND 22 WAS 104343	4-2-81	4-14-81
D	FIND 6 WAS 103950-3/4	4-2-81	4-14-81
E	FD 16 WAS 107379-0	4 2 81	6570



REF. DESG.	FIND NO.	QUAN REQ	PART NO. OR IDENTIFYING NO.	DESCRIPTION
R26	25	1	100549-1963	RESISTOR, 1% MF 196 K
R27	24	1	100549-1542	RESISTOR, 1% MF 15.4 K
	23	REF	403848	SCHEMATIC
	22	2	104343	PLUG, BANANA
	21	2	110344	KNOB
R29	20	1	1-107381-502	POTENTIOMETER (10TURN)
R43	19	1	107382-501	POTENTIOMETER, SPAN
R45	18	1	107382-203	POTENTIOMETER, BAL.
S3	17	1	107380-3	SWITCH, P.B. (R CAL.)
	16	2	107379-2	BINDING POST
	15	1	110547	KNOB, CONCENTRIC
	14	2	102066	WASHER, INS.
S1	13	1	202897	ASSY, ATTENUATOR
	12	1	110545	KNOB
S2	11	1	106736	SWITCH, ROTARY
R23	10	1	107382-253	POTENTIOMETER, GAIN
	9	1	110632	SHAFT LOCK
	8	1	110442	KNOB
R51	7	1	110735-203	POTENTIOMETER, POSITION
	6	2	103 50-3/4	SUPPORT, P.C.B.
	5	1	103750-5/8	SPACER, NYLON
	4	1	107291	STRAP
	3	1	202185	ASSY, P.C.B., VOLT. REG
	2	1	403850	ASSY. P.C.B., PRE-AMP
	1	1	B-402151	PANEL, FRONT

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES:
FRACTIONS ± 1/64 | TWO PLACE DECIMALS ± .010
ANGLES ± 1° | THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. MACHINE SURFACES TO BE 63 RMS.
MATERIAL:
FINISH:

DRAWN BY: JOHN HOLMES
DATE: 27-JUL-77
CHECKED BY:
DATE:
CONTRACTOR CERTIFICATION:
DATE:
DESIGN APPROVAL:
DATE:
DOCUMENTATION APPROVAL:
DATE:

gulton

MODULE ASS'Y
TSC-920

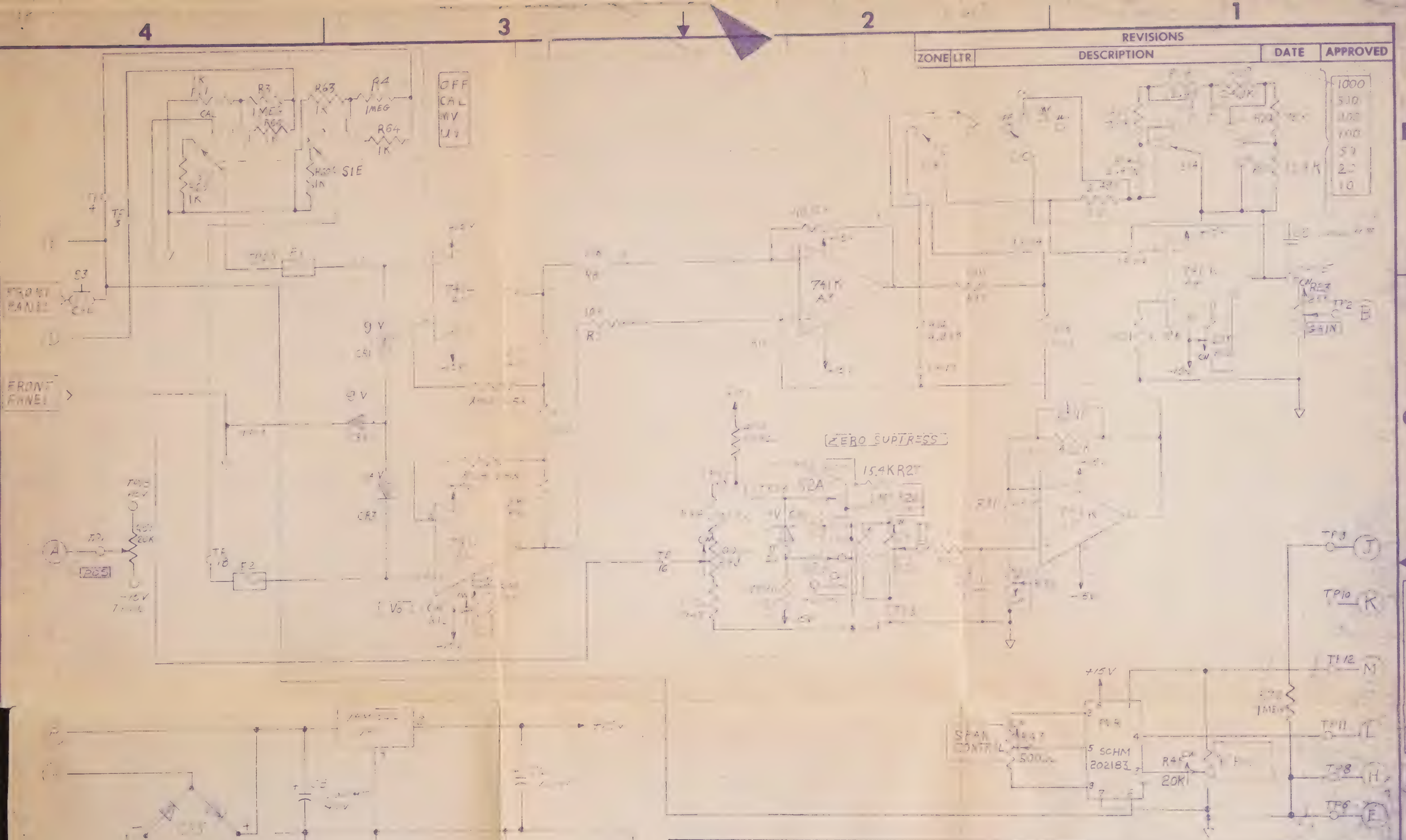
CODE IDENT	SIZE	DWG NO.
44	C	403625

SCALE	CONTRACT NO.	SHEET
1/1		1 OF 1

ENG. AUG 20 1982

AP-176

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



DWG SIZE	CODE IDENT	SPECIFICATIONS		QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST							

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES: TOLERANCES ON: FRACTIONS ± 1/64 — TWO PLACE DECIMALS ± .010 ANGLES ± 1° — THREE PLACE DECIMALS ± .005 REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. 63 MACHINE SURFACES TO BE ▽ RMS. MATERIAL	DRAWN BY: PHL — DATE 9·6·78 CHECKED BY CONTRACTOR CERTIFICATION: DESIGN APPROVAL: DOCUMENTATION APPROVAL:	Gulton techni-rite INCORPORATED ELECTRONICS SCHEMATIC TSC 920 PRE-AMPLIFIER SIZE C — CODE IDENT 70 — DWG NO. 403898 SCALE — CONTRACT NO. — SHEET OF

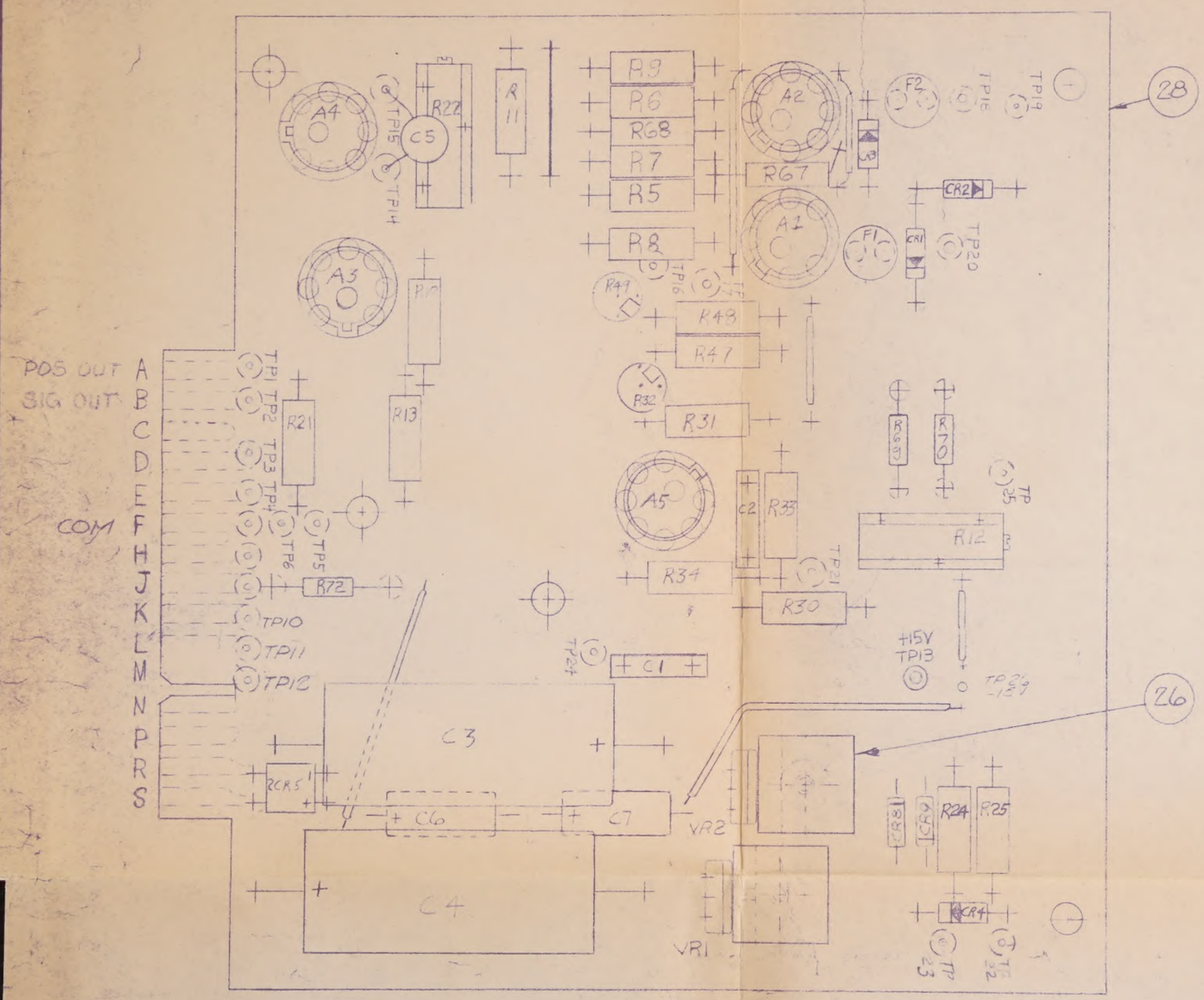
DWG SIZE	NEXT ASSY	USED ON
	APPLICATION	
	403853	TSC 920

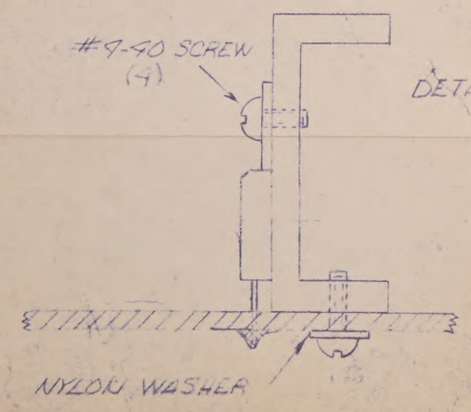
AUG 20 1982

AP 176.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	FD. 26 WAS 107377	1-22-81	46776
	B	ADDED JUMPER	2-9-81	46717

C	CHG. LOCATION OF [illegible]		2-23-81	46791	C
D	REVERSED POLARITY C	C3 & C4	3-6-81	40253	
E	REMOVED TP 26 TURRE		4-24-81	0577	





DETAIL VR1 & VR2

DWG SIZE	CODE IDENT	SPECIFICATIONS	REF. DES.	QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
			R72	1	44	100549-100A	RESISTOR ¼ W MF 1MEG Ω
			R7	1	43	100549-100R	RESISTOR 100Ω MF
			—	4	42	104537	RECEPTICLE
			F1, F2	2	41	107465	FUSE 1/100 AMP
			C5	1	40	100984-222	CAP .002 MF
			—	5	39	104305	TRANSISTOR PAD
				2	38	#4-40	LOCK WASHERS
				4	37	#4-40 X 3/8	RD HD SCREW
			—	X	36	403848	SCHEMATIC
			R32	1	35	103654-203	TRIMPOT 20K
			R49	1	34	103654-101	TRIMPOT 100Ω
			R48	1	33	100549-9092	RESISTOR 90.9K
			R47	1	32	100549-150R	RESISTOR 150Ω
			VR2	1	31	110017	REGULATOR -15V, 79M15UC
			VR1	1	30	110016	" +15V, 78M15UC
			R12	1	29	103354-103	TRIMPOT 10K
			PC1	1	28	403849	PC BOARD
			—		27	—	
			—	2	26	111010	HEAT SINK
					25		
					24		
			R33	1	23	100549-4992	RESISTOR 49.9K
			R31	1	22	100549-4532	RESISTOR 45.3K
			R30	1	21	100549-2492	RESISTOR 24.9K
			R24, R25	2	20	100549-499R	RESISTOR 499Ω
			R21	1	19	100549-4991	RESISTOR 4.99K
			R13, R34	2	18	100549-1002	RESISTOR 10K
			R22	1	17	103954-203	TRIMPOT 20K
			(R8, R9) (R10, R11)	2	16	1-100549-1002	RESISTORS MATCHED PAIRS 10K
			R67, R68	2	15	100549 7151	RESISTOR 1.15K MF
			R5, R6	2	14	100549-2001	RESISTOR 2K MF
			C6, 7	2	13	107128-106	CAPACITOR, TANT., 10μF
					12		
					11		
					10		
					9		
			CR5	1	8	106080-2	BRIDGE RECTIFIER
			CR4	1	7	104154	DIODE ZENER REF. 9V
			CR1, CR2, CR3	3	6	106696-9.1	DIODE ZENER 9.1V
			C3, C4	2	5	110565-106	CAPACITOR 1000 UF 40 V
			C1, C2	2	4	103993-684	CAPACITOR .68 UF
			R69, R70	2	3	100549-2002	RESISTOR 20K MF
			A3, A4, A5	3	2	201980	AMPLIFIER OPERATIONAL AD741K
			A1, A2	2	1	1-202062	AMPLIFIER OPERATIONAL 741L

PARTS LIST

DWG SIZE	NEXT ASSY	USED ON APPLICATION
	403625	TSC 920

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64 | TWO PLACE DECIMALS ± .010
ANGLES ± 1° | THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES.
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. 63 MACHINE SURFACES TO BE √ RMS.
MATERIAL

DRAWN BY: PALA DATE 3-6-78
CHECKED BY: DM 3/24/78
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

Gulton techni-rite® ELECTRONICS INCORPORATED
E.C. AUG 20 1982

ASSY PRE-AMPLIFIER PCB TSC 920

SIZE	CODE IDENT	DWG NO.
C	08	403850

SCALE	CONTRACT NO.	SHEET
2:1		1 OF 1

C 403850

PAP 176 ERASA DURE

Measurement & Control System Division
Gulton Industries, Inc., East Greenwich, Rhode Island 02818
401-884-6800 • TWX 710-387-1500

For Recorder Manual:

RM-4001